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GEOMETRIC RELAXATION OF SPACE-TIME: A MODEL OF METRIC TOPOLOGICAL RELAXATION; MASS-TO-METRIC CONVERSION

1. INTRODUCTION: THE DEADLOCK OF SINGULARITIES AND THE INFORMATION CRISIS

Modern theoretical physics has reached the limits of applicability of General Relativity (GR) and Quantum Field Theory (QFT). Einstein's GR [1] inevitably predicts singularities in the interiors of black holes (BHs)—points with infinite curvature, which is physically inadmissible. Stephen Hawking [4] showed that BHs must evaporate, giving rise to an "information paradox": the loss of quantum information about the structure of the absorbed matter.

The standard cosmological model, Λ CDM, attempts to save the situation by introducing Dark Energy (DE) and Dark Matter (DM). However, the lack of direct evidence for the existence of DM particles and the growing "Hubble Tension" [7] indicate the need for a new paradigm. In this paper, we propose the **Metric Topological Relaxation (MTR)** model, where spacetime is an elastic substrate and particles are its topological knots.

2. KNOT MORPHOLOGY AND THE NATURE OF CHARGE

In the MTR framework, elementary particles are stable solitons (knots) of the metric.

- Mass (m): A measure of the static tension energy of a knot.
- Electric charge (e): Interpreted as the chirality (direction of twist) of the fabric around a knot. Positive and negative charges are mirror images of torsional deformation.
- Interaction: The force between a proton and an electron is not an exchange of virtual photons, but an interference of deformation zones. Oppositely directed twists (charges) tend to cancel each other out to minimize the overall elastic stress (ϵ) of the system. This creates an attractive effect.
- Duality: The particle is the deformation core (node), and the wave is the accompanying metric tension train. Interference in a double-slit experiment occurs precisely in this train, while the node is localized.

3. A BLACK HOLE AS A "QUANTUM RECTIFIER"

In the proposed model, a singularity in a black hole is prevented by the Heisenberg uncertainty principle. When attempting to gravitationally localize a particle to a point ($\Delta x \rightarrow 0$), the internal tension of the node increases ($\Delta p \rightarrow \infty$). When it exceeds the elastic modulus of the vacuum ($\epsilon \approx 6 \cdot 10^{-10} \text{ J/m}^3$), the node "bursts" and "unravels."

- Phase destruction occurs: the knot structure (information) disintegrates, releasing binding energy in the form of a metric volume (ΔV).

- Conversion formula: $\Delta V = mc^2 / \epsilon$

This resolves Hawking's paradox: information does not disappear, but rather transitions from a local form (knot) to a distributed form (volume of space).

4. VERIFICATION: EXPERIMENTAL TESTS AND FALSIFICATION

The MTR model offers specific verification methods:

1. Casimir force gradient: In regions of high Dark Matter density (galactic halos), space is "squeezed." This should change the local value of ϵ , causing an anomalous shift in the Casimir force between plates compared to "empty" voids.

2. "Geometric exhaust" effect: Active galactic nuclei (AGN) should exhibit excess gravitational lensing that cannot be explained by their static mass. Light is further bent due to the process of generating the "here and now" metric (explanation of the JWST anomalies [3]).

3. Dark Matter Relaxation: Prediction of the absence of Dark Matter in old, "quiet" galaxies where BHs have ceased accretion (confirmed for NGC 1052-DF2 [6]).

Falsification Criterion: Direct detection of a Dark Matter particle (WIMP) or proof of the absolute homogeneity of the vacuum would refute the geometric nature of MTR.

5. COMPARATIVE ANALYSIS OF THE PROPOSED MODEL AND THE STANDARD MODEL

Description of Phenomenon, Standard Model (Λ CDM) vs MTR Model

Phenomenon	Standard Model (Λ CDM)	MTR Model
Dark Energy	Λ -constant	Dynamic relaxation of the fabric of spacetime as a result of the "untangling" of matter. In Black Holes
Dark Matter	Dark Matter: A substance, a hypothetical array of weakly interacting massive particles (WIMPs), which possess mass but do not participate in electromagnetic interactions. It is the "invisible substance" that fills space.	It is a state of spacetime. The inertial tension (compression) of space itself, arising as a dynamic response to the process of matter "smoothing" by black holes. These are not particles, but rather a "geometric stress" on the fabric of the Universe. A halo around black holes actively devouring matter, but absent around them at rest.
Black holes and Singularity	An inevitable dead end for the theory.	Topological tension release.
The relationship between QM and GTR	Conflict at small scales.	Unity through the elasticity of the metric.
Hubble Tension	The Gauge Problem.	Real local inhomogeneity.

6. CONCLUSION

The Universe is a self-regulating elastic system, striving to maximize entropy through the "smoothing" of matter. The transition from "particle physics" to "metric state physics" will allow us to unify all fundamental forces within the framework of a single geometric equation.

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